Occultation of Star by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
28 ...	29 Capricorni ...	6 ...	18 31 ...	19 34 ...	159 307

Dec. h.
27 ... 19 ... Mars in conjunction with and 3° 29′ south of the Moon.

GEOGRAPHICAL NOTES

SEVERAL recent German geographical periodicals refer to a paper read by Prof. Kan, of Amsterdam, before the Section for Geography and Ethnology at the fifty-ninth Congress of German Physicians and Men of Science at Berlin in September, urging on German explorers the necessity of undertaking a geographical and geological exploration of the Moluccas. He said that, although Europeans had settled in the islands for centuries, our knowledge of the orohydrography, especially of the physical features of the archipelago, was exceedingly small. Excellent charts exist in abundance, and travellers, English and German, have subsequently visited it; but they were neither geographers nor geologists, but as a rule studied only the fauna and flora. The Dutch Government has done nothing as yet in reference to the geography of the Moluccas, because it has turned all its energies to procuring good maps of the more extensive Sunda Archipelago. Java has been triangulated and surveyed; there are excellent charts of the coast of Sumatra, and the triangulation of this great island has also been commenced, and, in late years, maps of parts of Celebes and Borneo have been produced. In geology, those islands of the Sunda Archipelago which contain useful minerals have been studied, and excellent geological maps of Sumatra, Banka, Billiton, South-East and North-West Borneo have appeared. In addition, the Government places annually at the disposal of the Geographical Society of Amsterdam 10,000 florins, which, Prof. Kan hoped, would next year be applied to the exploration of the Aru Islands. On the whole, therefore, the Dutch authorities are not lax in surveying and mapping their possessions in the East. Besides the Moluccas, Flores and Timor still offer a virgin field to the explorer, and Prof. Kan hinted that the traveller who undertook the work would not lack pecuniary or other help in Holland.

THE last number of *Petermann's Mitteilungen* contains the conclusion of Lieut. von François's account of his journey in the Southern Congo basin, the present instalment being mainly occupied with climatology and detailed hydrographical observations. Dr. Philippi also concludes the very interesting paper, to which we have already referred, on the changes wrought by man in the flora of Chili. It contains systematic tables of the plants introduced into Chili, and which it now has in common with Europe. Dr. Emil Jung continues his examination of the last census returns of India, the special subject in this number being the effect of the last famine on the movement of the population. There is, further, a brief review of the new edition of Berghaus's "Physical Atlas," and notes on an excellent map of the Dobrudja, which is appended.

WE have also received the last supplementary number (No. 84) of the *Mitteilungen*. It deals with the economical geography of the whole of North America, and is really the first number of a series called *Archiv für Wistschaftsgeographie*. It treats of agriculture, forestry, mining, industry, trade, shipping, &c.

AT the last meeting of the Paris Geographical Society (November 19), M. Hansen-Blangsted read a communication on the physical appearance of Denmark in the middle of the eleventh century, as compared with the present time. M. Venukoff referred to the results of M. Nikolsky's studies last year of the physical geography of Asiatic Russia, especially the gradual drying up of Lake Balkash. The level of the lake is lowered by about 1 metre every fourteen or fifteen years. Two letters addressed to the Ministry of Public Instruction by M. Chaffanjon *en route* for the Upper Orinoco, were read, one from Ciudad Bolivar, the second, dated August 18, from Caicara. An interesting communication was read with regard to the last resting-place of Tavernier, the celebrated French traveller, who died in 1689. It was long unknown where he was buried, but it has at last been discovered to be the Protestant cemetery at Moscow. The question of the best method of permanently marking the grave was referred by the Society to a Committee. Capt. Longbois read a humorous account of a journey to Choa, which had for its object the exploration of the Awash and its basin.

THE current number of the *Boletin* of the Madrid Geographical Society contains an interesting account of Don Manuel Iradier's recent explorations in the newly-acquired Spanish territory on the west coast of Africa. The enterprising explorer paid two visits to this region—first in 1875-77, and again in 1884-85, during which he traversed 4000 miles between the equator and 3° N. lat., penetrating from the sea-board into the interior as far as about 20° E. long., and surveying to their sources all the coast streams between the Rio-del-Campo and the Gaboon. By far the largest of these rivers is the Muni, which enters the Atlantic in Corisco Bay, after receiving the contributions of the Utamboni, Noya, and other considerable affluents on both sides, and draining an area of nearly 6000 square miles between the Gaboon and the Rio San Benito. The whole of this river-basin is now Spanish territory, the protectorate having been everywhere accepted by the chiefs of the local tribes, who are collectively known as Vengas, and belong in type and speech to the Bantu family.

THE same *Boletin* reports the arrival in Lisbon of Major Serpa Pinto and Lieut. Augusto Cardoso, leaders of the Portuguese Expedition which has just completed the exploration of the region between Mozambique and Lake Nyassa. Starting from Ibo, south of Cape Delgado, the explorers advanced to the Mutepuezi River, and thence to Medo, where, Serpa Pinto falling ill, Cardoso took the lead. After traversing the Metarica district, the Lĭenda, an affluent of the Rovuma, was followed for some days, and found not to rise in Lake Nmaramba, but to flow through that lacustrine basin from Mount Songe, further to the west. From this point Lake Nyassa was reached in the Ki-Rassia district, whence the explorers proceeded by the familiar route down the Shiré to the Zambesi, and so on to Quilimane, on the coast. Being provided with excellent instruments, the explorers were able to take a very large number of astronomical and meteorological observations in a region now for the first time systematically surveyed.

THE prospectus has been issued in Vienna of a new geographical periodical to be called *Geographische Abhandlungen*; the editor is Prof. Penck, of the Vienna University, and Herr Hölzel is the publisher. It is not intended to compete with any existing geographical publications, but rather to supplement them. Each number will be complete in itself; compilations will be wholly excluded, and although a certain number will appear in the course of a year, the dates will not be fixed before hand, in order to leave the writers as unfettered as possible. The three numbers promised are on the glaciation of the Salzach district, the orometry of the Black Forest, and the arrangement or distribution of the Eastern Alps, by Drs. Brückner, Neumann, and Böhm respectively.

ON SOME FURTHER EVIDENCES OF GLACIATION IN THE AUSTRALIAN ALPS[1]

SINCE my announcement of the discovery of glacier evidences in the Mitta Mitta Valley ("On the Meteorology of the Australian Alps," *Trans. Roy. Soc. Vict.*, 1884, p. 23), and Dr. von Lendenfeld's subsequent discovery of traces of ancient glaciers on Mount Kosciusko ("On the Glacial Period in Australia," *Proc. Linn. Soc. N.S.W.*, 1885, p. 45), an interesting controversy has arisen respecting the nature and extent of such glaciation. Having recently undertaken an exploration of Mount Bogong, the highest mountain in Victoria, in company with Dr. von Lendenfeld, for the purpose of discovering further glacier evidences, and so aiding a solution of this important question, I have much pleasure in submitting the following remarks on the results of that expedition. It may be of interest to review my connection with the controversy as a student of physiography resident in the central part of the Australian Alps. During 1880-83, when studying the *flora* of the Australian Alps and collecting herbarium specimens for our venerable Nestor of botanic science, Baron von Mueller, it appeared to me that the date of the introduction of the endemic *florula* of the Australian

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[1] Paper read at the Linnean Society of New South Wales, on May 26, 1886, by James Stirling, F.G.S., F.L.S.

Alps (whose affinities were so closely Tasmanian) might safely be centred in glacial movements since Miocene times ("Remarks on Flora of Australian Alps," *Southern Science Record*, 1885, p. 93), provided geological evidences which would lend support to the hypothesis could be obtained; for, as remarked by the ex-President of the Linnean Society, Mr. Wilkinson, F.G.S., F.L.S., in one of his admirable addresses to the Society (President's Address, *Linn. Soc. N.S.W.*, vol. ix., p. 1236), the existence of a semi-tropic flora in South-East Australia during Pliocene times and its subsequent banishment from this region is evidence of a great change of climate in Post-Pliocene times.

In a paper which I have in preparation on the geographic range of the flora of the Australian Alps, it will be shown that many species found there between 2000 and 5000 feet have a wide range, recent researches on the flora of Morocco in Africa, and on that of Kurum Valley, Afghanistan, having disclosed the presence of numerous species of plants common to the Australian Alps; and as Sir Joseph Hooker remarked many years since in his splendid essay on the flora of Australia, "if as complete evidence of such a proportionately cooled state of the intertropical regions were forthcoming as there is of a glacial condition of the temperate zones, it would amply suffice to account for the presence of European and Arctic species in the Antarctic and south temperate regions of both hemispheres on the mountains of intermediate tropical latitudes."

As early as 1882 I discovered many examples of what appeared to be glaciated surfaces in the higher regions of the Australian Alps, notwithstanding that in some areas there were strong evidences of powerful sub-aërial denudation and erosion having taken place during Pleistocene times. *En passant*, I may mention that these apparently glaciated surfaces were seen on the quartz porphyries of Mount Cobboras at elevations between 4000 and 6000 feet; on the metamorphic rocks of Mount Pilot on the Pilot River Valley, down to 3000 feet; and on the granitic rocks of Mount Kosciusko, recently photographed by Dr. von Lendenfeld. Partly, however, from inexperience of glaciated surfaces elsewhere, I hesitated to pronounce authoritatively on them as glacier evidences until further opportunities were afforded me of discovering moraines and erratics at the lower levels. From the fact that my friend, Mr. A. W. Howitt, F.G.S., had not observed any appearances which he could in any way refer to a glacial period analogous with that of the northern hemisphere, unless (as he further remarks) the old lake basins near Omeo might suggest the action of ice ("Geology of North Gippsland," *Q.J.G.S. Lond.*, vol. xxxv. p. 35), I thought it very probable that any pre-existing evidences at the lower levels might have been scoured away by a subsequent pluviatile period ("On a Geological Sketch Section through the Australian Alps," *Trans. Roy. Soc. S.A.*, 1884).

The publication by my friend, Mr. G. S. Griffiths, of a paper on evidences of a glacial epoch in Victoria during Post-Miocene times (*Trans. Roy. Soc. Vict.*, 1884), induced me to re-examine the evidences at the higher altitudes, and to endeavour to follow the traces to lower levels in the Indi and Mitta Mitta Valleys, with the result that I felt justified in making the announcement previously referred to on December 11, 1884, even though some of the phenomena therein ascribed to glacier action might be found on closer scrutiny to have been produced by other causes. The indications taken as a whole were sufficient in my opinion to justify the hypothesis of glaciation, for on no other conceivable theory, as it appeared to me, could the facts as a whole be accounted for; while refrigeration of the area, and the consequent production of glaciers in the valleys of the Australian Alps over wide areas, would harmonise with conclusions deducible from an examination of the flora and fauna. In the beginning of January 1885, Dr. von Lendenfeld ascended Mount Kosciusko and photographed some glaciated surfaces. From the absence of any reference to my previous announcements save a mere reference from the *Southern Science Record* to the snow patches at the higher regions of the Australian Alps, I inferred that Dr. von Lendenfeld was unaware of my previous writings and discoveries, or he would not have stated in his interesting paper "On the Glacial Period in Australia," read before the Linnean Society of N.S.W. during January 1885, that the glacial area was limited to 100 square miles above 5800 feet altitude. On July 9 I published in the *Transactions* of the Royal Society of Victoria the first of an intended series of papers "On the Evidences of Glaciation in the Australian Alps," detailing certain phenomena in the Livingstone Creek and Victoria River Valleys. During the same month a paper, by Captain, now Professor, Hutton, F.G.S., of New Zealand, was read before the Linnean Society of N.S.W., "On the Supposed Glacial Epoch in Australia," being in part a reply to Dr. von Lendenfeld's previous writings concerning a very recent glacier epoch in the southern hemisphere, based upon New Zealand experiences and explorations, and partly an endeavour to show that the *roches moutonnées* and smoothed surfaces on Mount Kosciusko by no means imply, or, to use the actual words of the learned Professor, "it by no means follows, that they were caused by a glacial epoch, because they might equally well be due to greater elevation, combined with greater atmospheric moisture. We are also advised to "distrust an attempt to explain an *isolated phenomenon* by means of a wide-spread cause." Now it appears to me that Captain Hutton would not have assumed the isolation of the phenomena if he had been fully acquainted with the literature of the subject, and especially my announcement previously referred to. I do not propose to join issue with him in respect to the distinction he seeks to draw between a "glacier epoch" and a "glacial epoch," but merely to show that the phenomena of glaciation are not so isolated as his remarks would lead one to suppose he believes them to be. I am led to make these remarks because as a student of physiography I feel very much indebted to Prof. Hutton for the valuable information supplied by his writings concerning the geological structure, flora, fauna, and climatology of New Zealand, and I should be sorry to know that he laboured under any misapprehension as to the nature and extent of the evidences of glaciation in the Australian Alps. Following the publication of the papers of myself and Prof. Hutton we have one by Prof. Tate, F.G.S., of South Australia ("On Post-Miocene Climate in South Australia," *Trans. Roy. Soc. S.A.*, 1885), read before the Royal Society of that colony, in which are stated very clearly the evidences in favour of a glacial period in South Australia. The objections by Mr. Scoullar, Cor. Mem., as to the origin of the glaciated surfaces near Adelaide, viz. that they were caused "by the attrition of blown sand," are also controverted. I have seen some photographs of these glaciated surfaces (sent to me for inspection by Prof. Tate), and they resemble very strongly the glaciated surfaces on Mounts Cobboras and Bogong, to be hereinafter referred to. Dr. von Lendenfeld has also seen some photographs of polished rocks from South Australia, and has no doubt as to the glacier origin of the polishing ("Note on the Glacial Period in Australia," *Proc. Linn. Soc. N.S.W.*, vol. x. p. 330), although he doubts whether the striæ referred to are isochronal with the glacial traces he discovered on Mount Kosciusko. In consequence of a very interesting correspondence on the subject of glacier evidences between Dr. von Lendenfeld and myself, it was arranged that we should make a joint trip to the highest mountain in Victoria, Mount Bogong, and, if time and circumstances permitted, explore the Bogong High Plains to the south, and proceed thence along the main dividing range towards Mount Kosciusko, so that his extensive European Alpine experience and my local geological knowledge might be utilised, and the features discussed on the ground. On January 3, 1886, we met at Snowy Creek junction, a tributary of the Mitta, and on the following three days made the ascent of Mount Bogong from the north, an arduous journey, but still of great interest. Dr. von Lendenfeld has already described our journey in the publications of the Mining Department of Victoria (Mining Registrar's Returns for Quarter ended March), so that it is unnecessary for me to repeat the narrative. Suffice it to say that the evidences of glaciation discovered by us are:—

(1) Erratics in the Reewa River and Snowy Creek Valleys.
(2) *Blocs perches* and smoothed surfaces on Mount Bogong.
(3) Moraines at base of Mount Bogong, Mountain Creek in Reewa River Valley.

The first-named are abundant in the Pleistocene drifts at Snowy Creek, consisting of huge basaltic boulders, &c., in linear extension for miles, as at Granite Flat; the nearest basaltic outliers being fully twenty miles distant on Bogong High Plains, &c.

The second, or what I have called *blocs perches*, are large semi-rounded or sub-angular masses of igneous or rather plutonic rock—hornblende porphyrites—occupying the crests of spurs and sidelings in a regular descending series from near the summit of Mount Bogong, 6508 feet, towards the Reewa Valley, many of them resting upon smoothed surfaces of pegmatite at lower levels. (Mount Bogong is gneissic.)

The last-named are huge masses of angular and sub-angular rocks at the base of Mount Bogong, pronounced by Dr. von Lendenfeld to be undoubted moraines (at an elevation of 1000 feet above sea-level). I may remark that these masses are too extensive and distant from the steep spurs of Mount Bogong to be considered as *talus :* besides which they show evidences of translocation.

I do not purpose entering into a description of further evidences discovered by myself in the Mitta Mitta Valley, at Lake Omeo, or Benambia Creek, &c., in the present paper. There will in due course be communicated a second article on the evidences of glaciation in the Australian Alps, together with a reply to later criticisms. I merely desire to show that the evidences discovered on Mount Kosciusko by Dr. von Lendenfeld are by no means isolated, and that the highest mountain in Victoria, Mount Bogong, presents features which confirm the evidences of glaciation elsewhere, and that there is no *a priori* impossibility of the area of glaciation being more extensive than has been assumed. In conclusion, I would add that taking into consideration the facts supplied to us by the examination of the ancient flora and fauna of Australia as contained in the writings of Prof. Tate, of South Australia, and of Mr. Wilkinson, F.G.S., of New South Wales, and the geological evidences of glaciation over widespread areas daily accumulating, it is difficult indeed to resist the conviction that Southern Australia, as well as South America and Southern Africa, and indeed New Zealand, all participated in a period of refrigeration, culminating in an ice-clad region during later Pliocene or Pleistocene times, notwithstanding that many difficulties suggest themselves in endeavouring to work out the problem from mere localised observations.

SORGHUM SUGAR

SOME months ago considerable interest was excited by a report by Mr. Victor Drummond on the production of sugar from sorghum and maize. The report was sent from the Colonial Office to Mr. Thiselton Dyer, with a request that he would state his opinion on the questions raised by Mr. Drummond. For several years the importance of the subject had been recognised at Kew; and in his reply, dated August 10, 1886, Mr. Thiselton Dyer expressed his belief that if sugar could be produced at a cheap rate from sorghum and maize it would entirely take the place of cane and beet sugar, the geographical range of sorghum being far more extensive than that of the sugar-cane proper or of the beet. At the same time he drew attention to the fact that the results summarised by Mr. Drummond had been for the most part derived from laboratory experiments only, and that the question whether the new industry was likely to prosper could not be determined until those results had been tested over wide areas. He also pointed out that some statements in Mr. Drummond's report were at variance with well-known facts in vegetable physiology. Mr. Thiselton Dyer therefore advised that exact information as to the position of the sorghum- and maize-sugar industry in the United States should be obtained through the Foreign Office.

In accordance with this advice, copies of Mr. Drummond's report and Mr. Thiselton Dyer's letter were sent to Sir L. West. By him the matter was put into the hands of Mr. C. Hardinge; and now Mr. Hardinge's report has been published in the series of Foreign Office "Reports on Subjects of General and Commercial Interest." The sorghum-sugar industry has hitherto been conducted on a small scale. In 1884 it was carried on at eight factories, which produced 1,000,000 lbs. in all. The comparative insignificance of this result will be seen when it is stated that in 1885 the quantity of cane-sugar consumed in the United States was 1,170,000 tons. In most cases it was found that the cost of extracting sugar from sorghum exceeded receipts, and at the present time the industry is prosecuted at only two factories—that of the Rio Grande Company and that of the Franklin Sugar Company, whose works have been removed from Ottawa to Fort Scott.

Dr. Wiley, by whom the subject has been thoroughly investigated, attributes the failure of the industry, so far, chiefly to the following causes :—

(1) The difficulties inherent in the plant have been constantly under-valued. By taking the mean of several seasons as a basis of computation, it can now be said that the juices of sorghum, as they come from the mill, do not contain over 10 per cent. of sucrose, while the percentage of other solids in solution is at least 4, thus rendering the working of such a juice one of extreme difficulty.

(2) The chemistry of the process is at present hardly known, and great development is necessary in this direction.

(3) The area of land where the climate and soil are best adapted for the cultivation of sorghum is not nearly so extensive as was at first imagined, and investigation should be made in order to discover in which localities the necessary conditions are most favourable.

(4) Commercial depression and the consequent low prices have affected this industry, and caused failure and losses in cases where all other conditions were favourable.

(5) Lastly, the mechanical treatment of the juice is very imperfect, the machinery used in the mills being quite inefficient for the purposes intended.

In order that the last-mentioned defect might be corrected, the Commissioner of Agriculture decided that experiments for the application of the process of diffusion on a practical scale should be carried on with the best machinery possible, and the direction of the experiments was intrusted to Dr. Wiley. He erected the battery and necessary buildings in connection with the works of the Franklin Sugar Company at Ottawa, Kansas, and the first trial of the process of diffusion was made on October 8, 1885. The general results of the experiments of 1885 show that :—

(1) By the process of diffusion 98 per cent. of the sugar in the cane was extracted, and the yield was fully double that obtained in the ordinary way.

(2) The difficulties to be overcome in the application of diffusion are purely mechanical, and by enlarging the diffusion-cells to a capacity of ·130 cubic feet, and by making a few changes in the apparatus, it would be possible to work 120 tons per diem.

(3) The process of carbonatation for the purification of the juice is the only method which will give a limpid juice with a minimum of waste and a maximum of purity.

(4) By a proper combination of diffusion and carbonatation, 95 per cent. of the sugar in the cane can be placed on the market, either as dry sugar or molasses.

When his experiments were ended, Dr. Wiley was instructed by the Commissioner of Agriculture to proceed to Europe for the purpose of inspecting and purchasing such forms of machinery as might appear most useful, also to gain such information as might secure the greatest success in this work; and Mr. Hardinge reports that much useful information, chiefly of a mechanical nature, was obtained by Dr. Wiley during the course of his visits to several of the most important sugar factories in France, Germany, and Spain.

During the season of 1886 further experiments have been carried on at Fort Scott, under the direction of the Department of Agriculture, and the results have not proved to be as satisfactory as was anticipated.

ON THE CUTTING OF POLARISING PRISMS[1]

THE author showed the manner of cutting two new polarising prisms, designed by Ahrens and by himself, and described and figured in the *Phil. Mag.* for June 1886. The Ahrens polariser is a rectangular parallelopipedon of calc-spar having square end-faces, and having its long sides in the proportion of about 1·6 : 1 relatively to the short sides. The square end-faces are principal planes of section of the crystal. Two oblique sections are cut in the prism, being carried through the top and bottom edges of one end-face, and meeting in the horizontal middle line of the others. The dihedral angle between these planes of section is about 32°. The faces are polished and reunited with Canada balsam in the usual way. The advantages claimed for the new prism are: (1) decrease in length, (2) increase in angular aperture, (3) saving of light consequent on non-obliquity of end-faces, (4) minimum of distortion, (5) less spar required than in Hartnack, Glan, or Thompson prisms of same section. Against this are the slight disadvantages of (1) the line of section across end-face, and (2) the use of more spar than a Nicol of equal section. But Mr. Ahrens has recently added a thin covering-glass at the end-face crossed by the line of section, thereby making this line almost imperceptible; and he has also succeeded in finding a new method of cutting the prism in which there is extremely little waste of spar. The other prism designed by the author is a simple modification of the Nicol, giving a wider angle of field. A wedge is cut off

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[1] Abstract of a Paper read at the Birmingham meeting, 1886, of the British Association, by Prof. Silvanus P. Thompson.